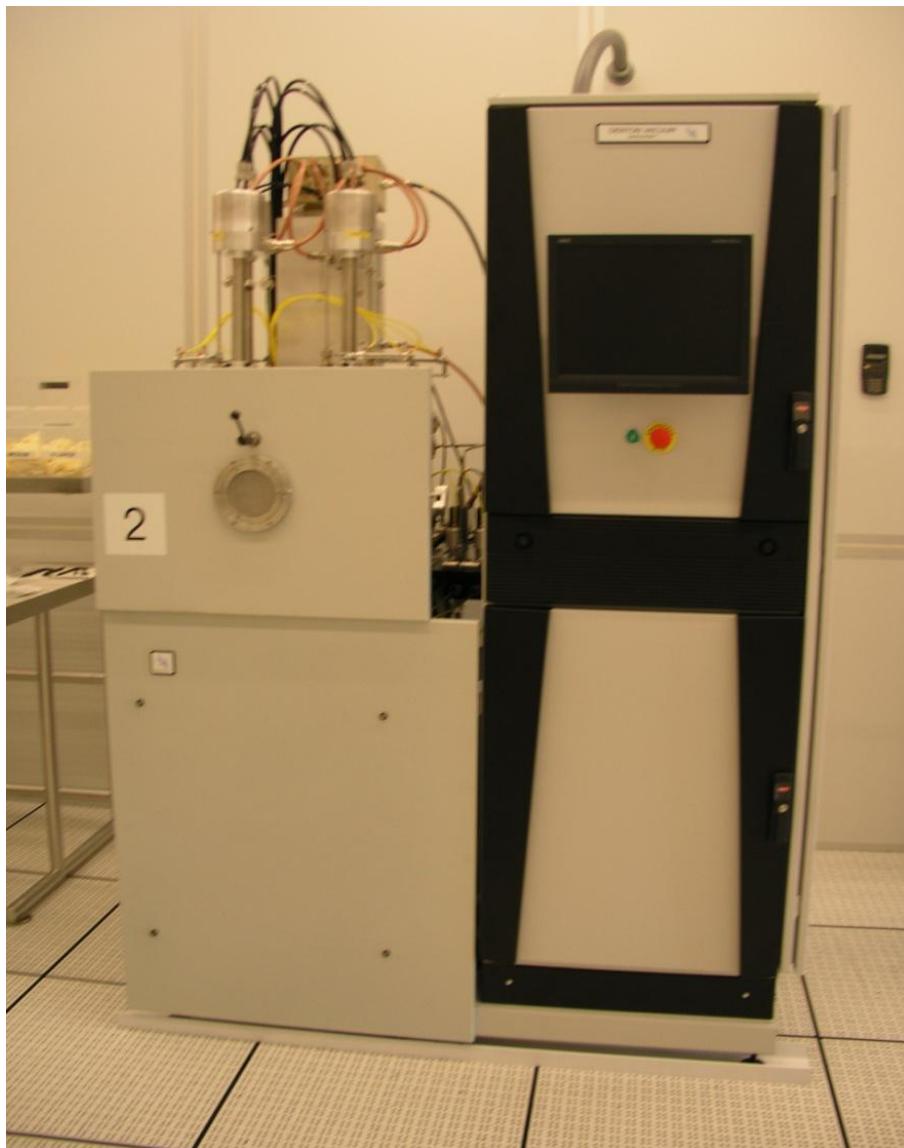


Denton Discovery-550 Vacuum Sputtering System Users Manual



Coral name:	Sputter 2
Model:	Discovery 550
Location:	CNST NanoFab, Building 215, Room B104
Contact:	nanofab_metaldep@nist.gov
Version:	1.0

1. Overview

This sputtering tool is designed for the deposition of metals and insulators with thicknesses ranging from ~1 to several hundred nm. The sample or wafer sits on a rotating platform centered at the bottom of the chamber to ensure uniformity. This tool is especially useful when used in the automatic mode for depositing multilayers.

2. Safety Precautions

Make sure all interlock indicators on the **Overview** screen are green when you come to the tool. If not, notify NanoFab staff.

Liquid nitrogen is extremely cold. Always wear your safety glasses when filling the trap

In case of emergency, hit the red EMO push button and notify staff.

If you need to abort the run for any reason, click the **Abort** button on the overview screen. The tool will return to a safe standby state.

3. Special Notes and Restrictions

You must be qualified to use this tool

The tool must be enabled in Coral. Do not forget to disable it once your run is completed

Sign in and enter your run information in the logbook

The current materials loaded in the cathodes are displayed on the overview screen and also in **Coral**: highlight the tool, go to the maintenance tab and look up the last “comment”. Contact NanoFab staff at least one day ahead of time of any material you need loaded.

Contact NanoFab staff for any new material to be deposited

A spreadsheet listing the parameters and deposition rates for all available materials is posted on the tool for your reference

When switching between DC cathodes in a multilayer process, you must insert a short (5s) “spacer” step in your recipe to ensure the power is completely off before switching. Such a step is not necessary when switching between RF cathodes or from DC to RF or vice-versa.

4. System Description

- The tool has four cathodes. Two DC cathodes (# 1 and #2) located in the back and two RF cathodes (#3 and #4) located in the front. RF cathodes can be used for any type of material. Electrical insulators must be deposited with RF cathodes. Metals can be deposited with either DC or RF cathodes.
- The tool is equipped with one RF and one DC power supplies, allowing co-deposition from one DC and one RF targets.
- The pumping system consists of a turbomolecular pump backed by a mechanical pump (located in the chase). The ultimate vacuum after ~24-hour pumpdown is 8E-8 Torr. Typical vacuum used before deposition is 3E-6 Torr, reached within ~20 minutes after start of pumpdown.
- Two gases are plumbed in this tool: Gas#1 is oxygen (0-200sccm range). Gas#2 is Argon (0-100sccm).
- Deposition recipes are written in an Excel spreadsheet and stored within one single folder for all users. In order to keep all your recipes “together” and easy subsequent retrieval, it is advisable to name your recipes starting with the 2 or 3 initials of your name.

5. Step-by-step Instructions

On **Overview** screen, press **Autovent**. It will take ~2 minutes for the chamber to reach atmosphere.

Slide platen out of chamber and load wafer or sample. It is advised to secure the sample with small pieces of Kapton tape to ensure the sample will not slide during platen rotation. Load platen in chamber.

Close and latch door. Press Autopump.

Open the liquid nitrogen faucet to the trap in back of the tool. One turn is enough. When the trap is full (~5 minutes), close the faucet. The trap will remain cold for 2-3 hours and speed up the pumpdown.

Write and/or load the recipe you need.

Press **Start**. The tool is programmed to start running your recipe once the **Vacuum Setpoint** of your recipe is reached.

Once the deposition is complete, you will be prompted by the **Auto Process Complete** signal.

Wait approximately 5 minutes to ensure cathodes have cooled down

Press **Autovent**

Open door, remove sample, place platen back in chamber and press **Autopump**.

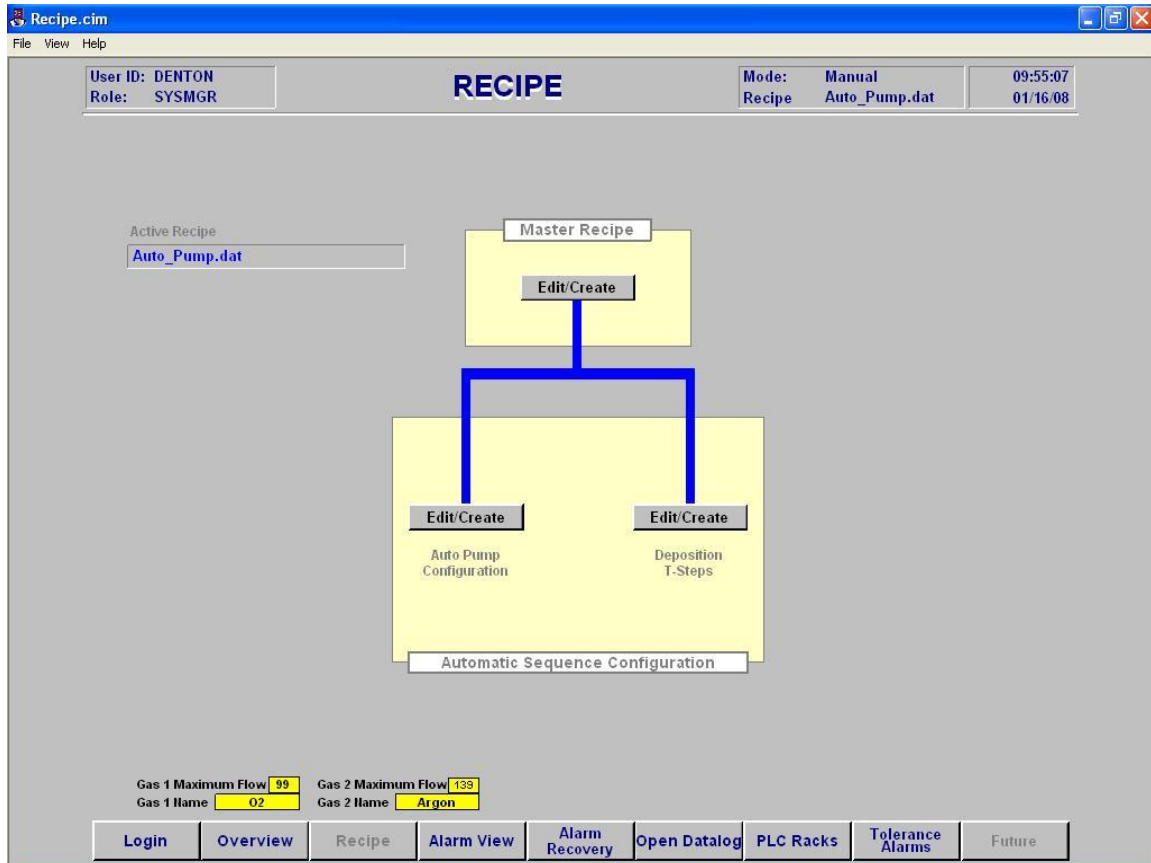
Note: it is always a good practice, like with any other vacuum system, to minimize the time the chamber is open to atmosphere.

6. Creating Recipes



NOTE: Maximum Filename length is 16 characters. If longer, recipe will not start

RECIPE



Master Recipes consist of one or more automated preprogrammed steps. Master Recipes are saved as files for future use. Each step in a recipe consists of a Building Block or Automated Sequence Configuration. Use the Recipe screen for all recipe-building functions. System operators and administrators can access Master Recipes.

Non-Programmable Sequence Configurations are programmed at the factory and cannot be reprogrammed by an operator. Programmable Sequence Configurations can be programmed and saved as files for future use. Programmable Sequence Configurations are not accessible to operators. The System Administrator clearance is required to access Programmable Sequence Configurations.

Auto Vent (Chamber or Load Lock) is factory-programmed to be the last step in all recipes to vent the system to atmosphere safely. The Vent Delay time is programmed in the Auto Vacuum Configuration.

T-STEPS CONFIGURATION (AUTOMATIC DEPOSITION)

Microsoft Excel - DentonSput_NIST.xls [Read-Only]

	Step Number	T000	T001	T002	T003	T004	T005	T006	T007	T008	T009	T010	T
	0 Step Time (sec)												
New	1 Min Vacuum Setpoint (Torr)												
Open	2 Heat Temperature Setpoint (Deg. C)												
	3												
Save	4 Gas1 - Setpoint (sccm)												
	5 Gas2 - Setpoint (sccm)	sccm											
Delete File	6												
	7												
Save As	8												
	9												
	10												
	11												
Insert Column	12												
	13 RF Source - PreSputter (Watts)												
Delete Column	14 RF Source - Sputter (Watts)												
	15 RF Source Select												
	16 DC 1 Source - PreSputter (Amps)												
	17 DC 1 Source - Sputter (Amps)												
	18 DC 1 Source Select												
	19												
File Name	20												
	21												
	22 Pressure Control												
	23 Ignition Pressure (mTorr)												
	24 RF Bias Setpoint												
	25 Rotation Speed												
Close	26 End Process (Yes)												
	27												
	28												
File Directory		C:\Cimplicity\Discovery\Deposition\											

The Automatic deposition process in this Discovery system is designed to follow a programmable timeline. The programming of the automatic process is organized into a spreadsheet format. Each column is a programmable time segment. The programmable data in the column is active for the time period programmed into the first cell of the column.

Maximum number of seconds (Step Time) per column = 3200 seconds (53.3 minutes)

Programming beyond the 3200 seconds per column is achieved by continuing the same set of operating parameters across more than one column. The net result will be a continuation of all existing operational parameters across multiple time segments. There is no limit to the number of identical consecutive Time Steps.

Maximum number of Steps (columns) = 250

Programming beyond the 250 Step maximum is achieved by creating multiple T-Step recipe blocks (of 250 or less Steps each) and executing them sequentially in a Master Recipe file. Detailed instructions are provided later in this section of the manual.

Maximum number of T-Step columns in a Master Recipe = 799

Each column in a T-Step spreadsheet is converted into an individual Master Recipe step when it is added into a Master Recipe File. Multiple T-Step files can be added to a Master Recipe file to reach the 799-step maximum. Programming a Master Recipe beyond the 799 steps is not possible.

Assuming a maximum time for each step (3200 seconds) and a maximum number of steps (799), a single Master Recipe can be programmed for over 700 hours of continuous automatic operation.

PROGRAMMING A T-STEP FILE

From the Deposition T-Step screen, begin by selecting the OPEN or NEW buttons in the upper left hand corner of the page. Either select an existing recipe or create a new one.

There are two methods of input into the individual cells:

Digital input (i.e. 0 –100) and;

Dropdown selection boxes (i.e. yes/no, PID/Fixed, etc). Selection inputs are viewed in a “drop down” box, which requires a mouse click in the box.

To create a new process, follow these guidelines:

Step Time (sec) - Each column is a TIME SEGMENT of the process. The **T(ime) - Step** entry on the 1st line in each column sets the duration of that step. All settings for that column will be active for the amount of time programmed into the first row of the spreadsheet.



NOTE: Certain functions will delay the countdown of this timer! Delays include: system waiting to achieve minimum vacuum level, Heat Temp setpoint, and Ignition pressure setpoint.

Minimum Vacuum Setpoint – This pressure setpoint **MUST** be reached before this step will execute.

Heat Setpoint - This temperature setpoint **MUST** be reached before this step will execute.

A value must then be input into the Gas Setpoint row of each gas for which gas flow is required. (Leave a blank or input a zero into any Gas Setpoint row for which NO flow is required.) This input should be a 0 – 100% value.

NOTE: The Gas Setpoint value is NOT a flow setpoint when PID is selected. The value is a percentage (0 – 100%) and is used to program the gas mixing ratios of the individual gas flows.

Source power settings (**RF or DC**) must be programmed for each source.

Select a cathode (#1, #2, #3, or #4) for DC or RF power.

Input a PreSputter power setting for preparation of the target material before the source shutter is opened.

Input a Sputter power setting for operation of the cathode after the shutter is opened.

NOTE: The individual source shutters will open on the transition from PreSputter to Sputter for each active source.

If downstream pressure control is desired, the **Pressure Control** selection must be set to 'yes'. This will activate the Pressure Control Mode (PCM) of the High Vacuum Valve.

If the RF cathode requires a higher pressure to ignite than obtained with the selected flow, then an Ignition Pressure must be programmed.

This pressure must be identified by manually operating the source under a specific set of parameters and testing for an ignition pressure that will assure proper ignition of the RF plasma. These parameters must then be stored in a Deposition T-step file for use in Automatic processes.

During an automatic process, gas flow will be initialized; the High Vacuum Valve will close; the RF power supply will be switched On when this pressure setpoint is reached. The High Vacuum Valve will then immediately open and all process parameters will stabilize.

Enter a setpoint into the **Ignition Pressure** row to set a pressure limit for igniting RF plasma.

An Ignition Pressure setpoint is required any time an RF power supply will be started.

When an RF supply is to be started, the Gas valve(s) will first open to the flow or pressure setpoints, then the High Vac Valve will close until the Ignition Pressure is reached before the RF supply is activated ON.

Enter a setpoint into the **Rotation Speed** row to program the desired rotation speed that will be active.

To end a process, you must select 'Yes' in the **End Process** row.



NOTE: A 'Yes' selection is required in the last column of every Deposition T-step file. The Save function will not permit you to save a file without a 'Yes' selection in the End Process row.

With these guidelines in mind, you will be able to program all desired functions for heat, etching, depositions with and without bias multiple gas flow and control modes, and multiple cathode selections / usages. Film thicknesses are controlled via the power settings and the length of time (sum of T-Steps) in which the gun has a power entry.

- **NOTE: When switching from one RF target to the other, you need to insert a short (5 sec.) "spacer" step to allow the power supply to shut off completely prior to igniting the second target. Keep the gas, rotation and pressure control running during this step. The same holds when switching from one DC target to the other.**
- To save a recipe, simply click the SAVE button, assign a name and click OK. Then click the close button to go back to the MASTER RECIPE page.



NOTE: A 'Yes' selection is required in the last column of every Deposition T-step file. The Save function will not permit you to save a file without a 'Yes' selection in the End Process row.

To create a new recipe from an existing one, use the OPEN button and click on a recipe to highlight it and use the **OPEN** button on that page. The spreadsheet will populate the data boxes with the stored information in that file. You may edit the values and the T-Step commands.

Using the COLUMN buttons you can insert steps as needed or delete steps. Once the appropriate changes are made, click on the **SAVE AS** button, edit the recipe name for a new one, and ENTER. **Maximum number of characters in file name: 16**

Insert Column will insert a column before the column selected.

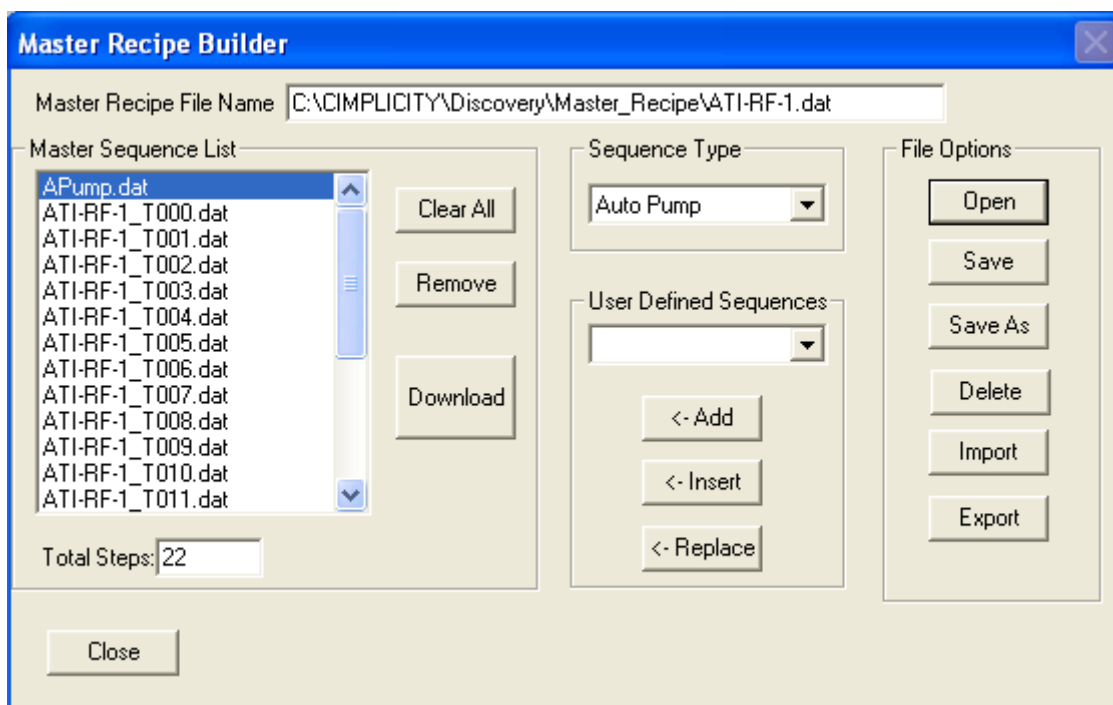
Delete Column will delete the active column.

<div>Save As</div> <div>Insert Column</div> <div>Delete Column</div>	<div>File Name</div> <div>RF_DC_T2</div>
	<div>Close</div>

The new recipe name will show in the file box now. Click the **CLOSE** button to bring you back to the MASTER RECIPE screen.

Once you have assigned a name and saved it, the recipe will be downloaded to the MASTER RECIPE FILE. It can now be retrieved in that page, by clicking on the EDIT/CREATE button.

MASTER RECIPE BUILDER



The **Master Recipe** screen is accessed through the **Recipe** screen.

New recipes are created using the Master Recipe Builder Screen. Recipes that have been saved as files are accessed through the Master Recipe Builder Screen.

The File Option buttons on the right side of the screen allow an operator to Open or Delete existing files; Save new files or Save As new recipes as old file names.

When a recipe file is Open, the steps in that recipe will be displayed in the Master Sequence List window. The total number of steps in the active recipe file is displayed.

The Download button is used to download the recipe displayed in the Master Sequence List into the PLC.

The Import and Export buttons convert the displayed file into a format that is compatible with MS Excel. This file can be displayed, stored or printed with Microsoft Excel spreadsheet

software. Every system is supplied with Microsoft Excel. These files can be easily be copied to disk and transferred to other computers.

The Clear All, Remove, Add, Insert and Replace buttons are used to modify the steps in the Master Sequence List.

Use the mouse to move the blue highlighted area up and down in the Master Sequence List Window.

Use the Sequence Type window to select the required Sequence Configuration or recipe step.

Use the User Defined Sequence window to select the saved files under each Sequence Configuration type.

EXAMPLES:

Sequence Type: Auto Deposition

User Defined Sequence:

Cath1DC.dat

Cath3DC.dat

Sequence Type: Auto Heat

User Defined Sequence:

heatest.dat

heatest1.dat

CREATE A NEW RECIPE

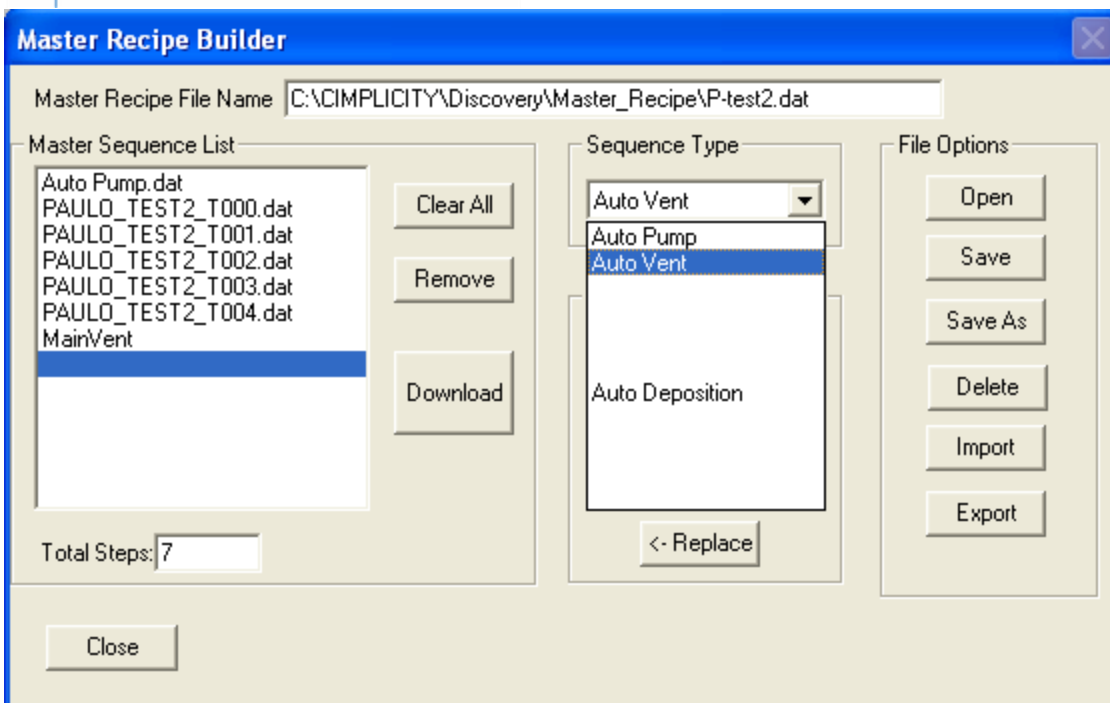
Open the Master Recipe Builder screen from the Recipe screen.

Press the Clear All button to clear the Master sequence List.

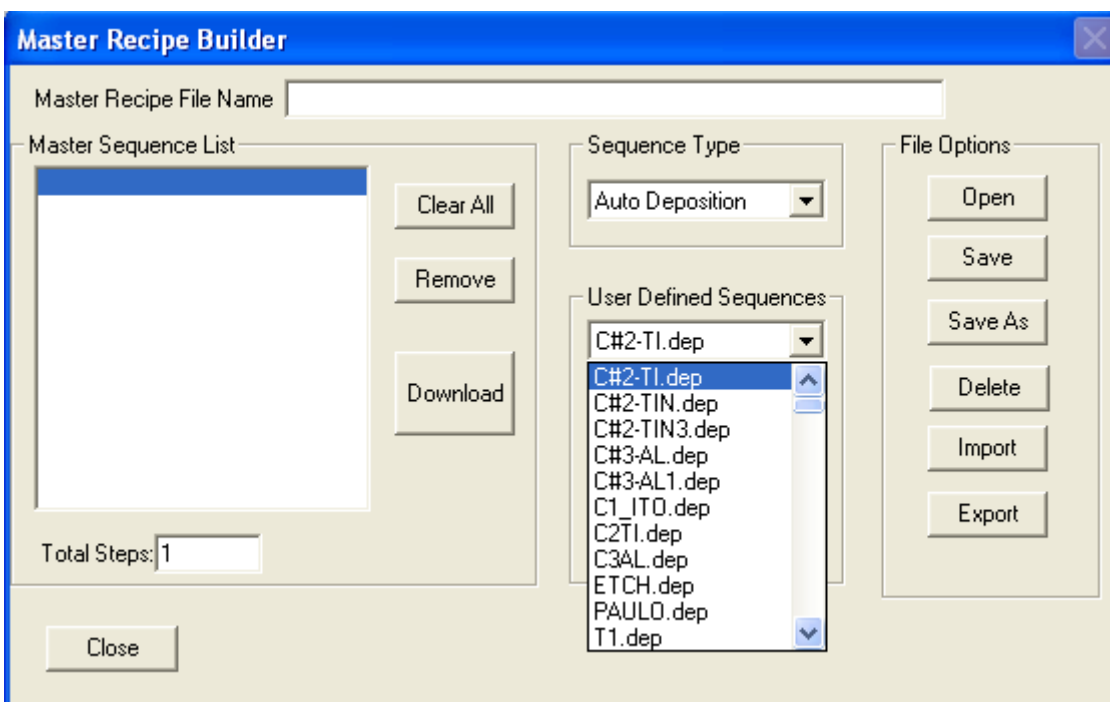
Use the mouse to direct the blue highlighted area to the top of the Master Sequence List.

Push the arrow button under Sequence Type to display the Sequence Configurations.

Use the mouse to highlight the selected Sequence Configuration (i.e. LL Vent).



Push the arrow button under User Defined Sequence to display the saved files under the Sequence Configuration folder (i.e. C1C2C3.dat)



Press the Add button to add this step to the Master Sequence List.

Use the mouse to direct the blue highlighted area to the next step of the Master Sequence List.

Push the arrow button under Sequence Type to display the Sequence Configurations.

Use the mouse to highlight the selected Sequence Configuration (i.e. AutoHeat).

Push the arrow button under User Defined Sequences to display the saved files (i.e. heatest).

Use the mouse to highlight the selected saved file.

Press the Add button to add this step to the Master Sequence List.

Use the mouse to direct the blue highlighted area to the next step of the Master Sequence List.

Repeat this until all required steps are listed on the Master Sequence List.

The Remove button will remove the highlighted step. The Replace button will replace the highlighted step with the highlighted User Defined Sequence.

When a Recipe is complete, it must be saved as a Recipe File. If you want to save the new recipe under an old file name press the Save As button to select the old file name.

Maximum number of characters in file name: 16

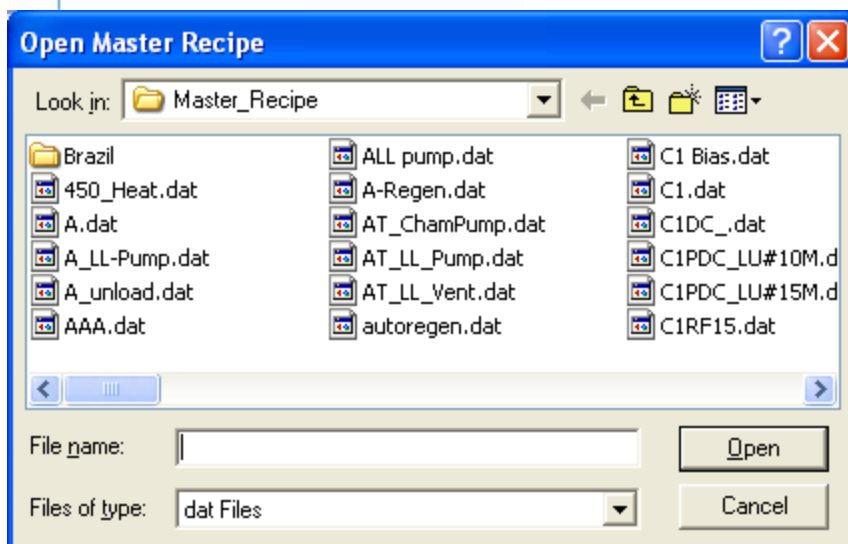
To use the new Recipe, press the Download button to download it into the PLC. It will then become the active recipe on the Overview Screen.

NOTE: PRESS CLOSE BUTTON TO CLOSE THE CONFIGURATION SCREEN

USE AN EXISTING RECIPE FILE

Open the Master Recipe Builder screen from the Recipe screen.

Press the Open button.



Select the recipe file and double click the left mouse button.

The selected recipe will be displayed in the Master Sequence List.

Use the Remove, Add, or Replace buttons to change the steps in the recipe if necessary.

Press the Save or Save As button to save the new recipe if you have made changes.

To use the existing Recipe file, press the Download button to download it into the PLC. It will then become the active recipe on the Overview Screen.

NOTE: PRESS CLOSE BUTTON TO CLOSE THE CONFIGURATION SCREEN.

START A RECIPE

Now that you have named and saved your new recipe, or have selected an existing recipe, and it is loaded in the MASTER SEQUENCE LIST box on the MASTER RECIPE BUILDER page, just click the DOWNLOAD button. The recipe's name will appear in the ACTIVE RECIPE block. It will also now appear on the system overview screen in the RECIPE NAME block (upper left hand corner) located in the SYSTEM CONTROL zone.

Press the START Auto Sequence button to initialize the Auto deposition process.

The automatic process selected will be executed. When the T – Step portion of the process begins, the recipe steps will be displayed next to the "System Control" zone.

An alert message will appear on the Overview screen when an automatic process has completed successfully.

System Control

Auto Manual Service

Recipe Name
C3_SiO2_50Min.dat

Current Step 3 of 4

Sequence Running
C3_SiO2_50M_T002.dat

Process Time Run Number
00:04:49 83 **Reset**

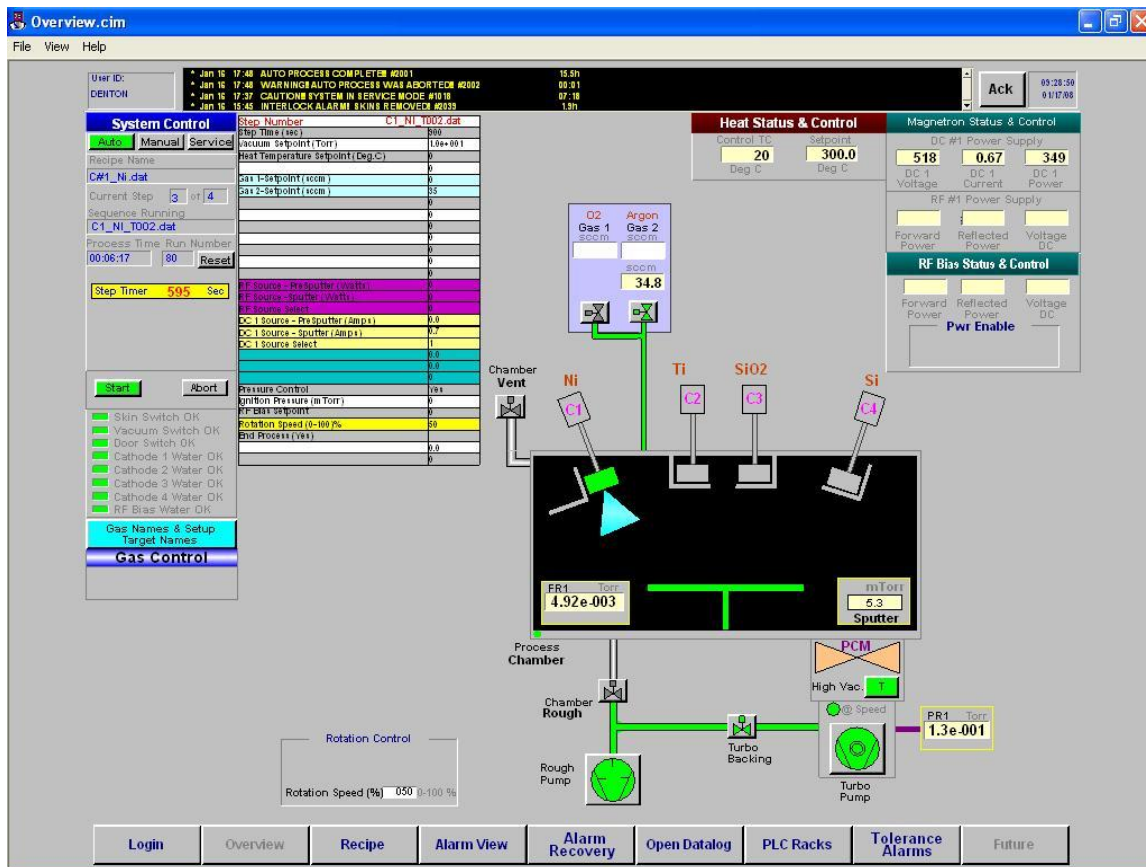
Step Timer 2910 Sec

Start **Abort**

Step Number	C3_SiO2_50M_T002.dat
Step Time (sec)	3000
Vacuum Setpoint (Torr)	1.0e+001
Heat Temperature Setpoint (Deg.C)	0
	0
Gas 1-Setpoint (sccm)	0
Gas 2-Setpoint (sccm)	35
	0
	0
	0
	0
	0
	0
	0
RF Source - PreSputter (Watts)	0
RF Source -Sputter (Watts)	350
RF Source Select	3
DC 1 Source - PreSputter (Amps)	0.0
DC 1 Source - Sputter (Amps)	0.0
DC 1 Source Select	
	0.0
	0.0
	0
Pressure Control	Yes
Ignition Pressure (mTorr)	0
RF Bias Setpoint	0
Rotation Speed (0-100 %)	50
End Process (Yes)	
	0.0
	0

Auto Process End O.K.

7. Additional Information



The control system for the vacuum system is GE Cimplicity® HMI (Human Machine Interface). Cimplicity® runs on a Windows operating system. This should make the interface between operator and machine familiar and easy to learn.

This software links the operator to the PLC. It allows for data input and data display. Operators can use a mouse to select on-screen graphics by clicking on any active element on a screen. Data is input by pushing on-screen buttons or using the keyboard.

Security is implemented through the Login Panel. Multiple levels of security are available to control access to critical information. The System Administrator has complete access to the entire control system. The System Operator can access everything except the heat PID settings, Service Mode and the Configuration Screens in the Recipe Builder. System Security is described in detail in the System Security section of this manual.

This software is active when power is applied to the system.

Graphic display of the control system is arranged on seven “screens”:

Main Menu (Login)

Overview

Recipe

Alarm View

Tolerance Alarms

Datalog

PLC Racks

Main Menu (Login) is the first screen active when power is applied. It gives the operator access to the other screens through push buttons at the bottom of the screen. Access to the Login software is through this screen.

Overview is the primary operating screen. All current system data is displayed on this screen. The operator can access all subsystems through this screen. The Auto, Manual, and Service Modes are selected on this screen. Automatic sequences are Started, Stopped and Reset on this screen. This screen is described in detail in this section of the manual.

Recipe screens are used to develop, store, and download recipes for automated processes. Recipe screens are fully described in the [Recipe Builder](#) section of this manual.

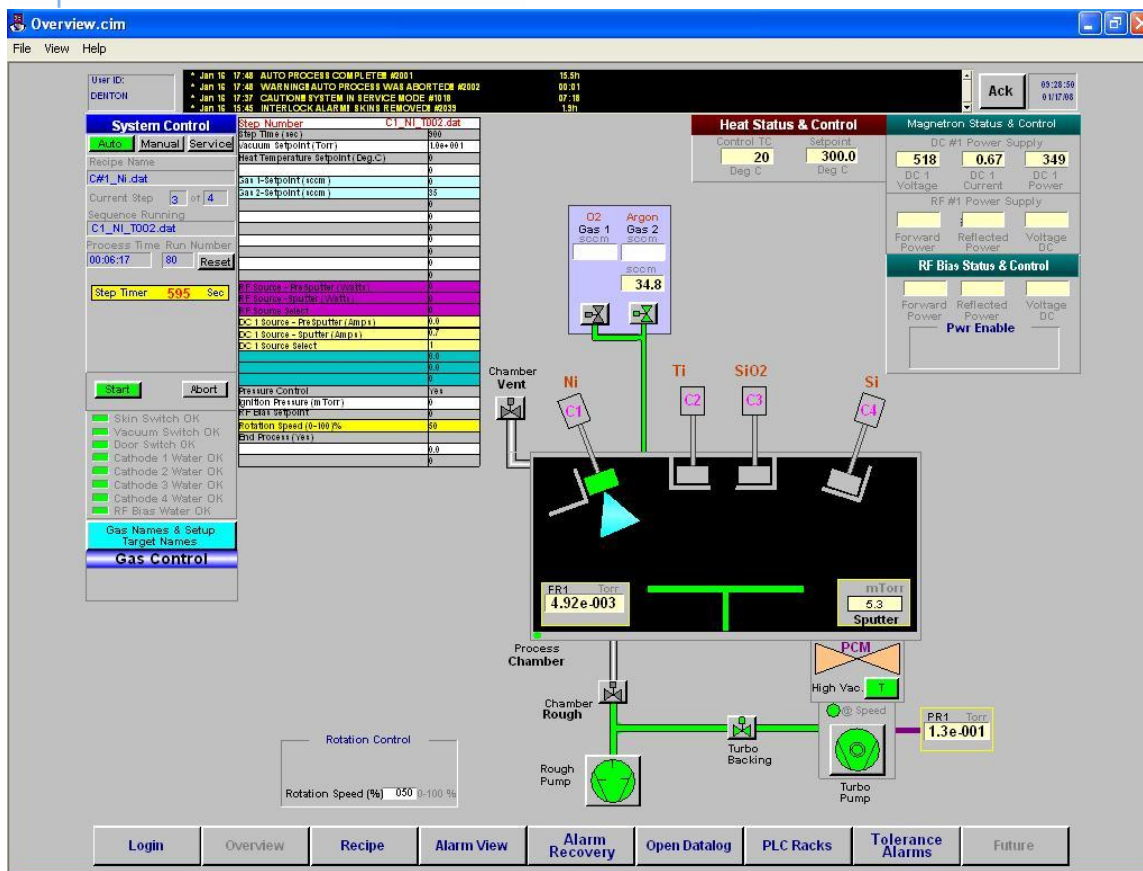
Alarm View is the screen used to display, acknowledge, and clear system alarms. Alarm View is fully described in the [Alarm](#) section of this manual.

Tolerance Alarms is a screen that displays the adjustable alarm settings for all of the adjustable cathode alarm setpoints. This screen is fully described in the [Alarm](#) section of this manual.

Open Datalog provides access to the Datalog files of the operating system. All Datalog files are available in Microsoft Access. This feature is described in the [Datalog](#) section of this manual.

PLC Racks is a screen that displays the live status of the inputs to and outputs from the PLC. This screen is fully described in the [Alarm](#) section of this manual.

This Chapter will describe the **Overview** screen. An understanding of this screen is required to proceed with the operation of the vacuum system.



OVERVIEW SCREEN

The Overview screen is used to display current system data and provide manual control of subsystems. The system data and security access level are displayed across the top and down the left side of the screen. The current state of the vacuum chamber and the pumping system are graphically displayed in the center of the screen. Subsystem control boxes are accessible on the right side of the screen. Push buttons across the bottom are used to switch to Main Menu, Recipe, Alarm View, Alarm Recovery and PLC Racks screens.

Pushbuttons change color to indicate the state of the switch. Valves, pumps, and interlocks change color to indicate current state. Graphic indicators are displayed on the vacuum system graphic when sputter sources, heater, mass flow controllers or bias table are active.

All operations are familiar Windows operations. All graphics that are accessible to the operator will display a white "lasso" when the cursor is near the graphic. The valves, pumps, timers, and individual control boxes are activated by a single click on the mouse. Data is input into a data box by clicking on the data box, typing in the data, and pressing the ENTER key.

TOP OVERVIEW BAR

User ID: DENTON1	Oct 17 16:10 AUTO PROCESS COMPLETE!!!! #2001	00:58	Ack	16:11:54 10/17/03
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Displays current security data (User ID), time of day and date. The User ID is factory set in the control system software. The current Login name is displayed here. The time and date can be adjusted in the Windows Control Panel.

Alarm messages appear in this area. The ACK button can be used to acknowledge an active alarm.



Please note that the ACK button will silence an active audible alarm, but the audible alarm will reactivate in 60 seconds if the alarm condition is not corrected.

LEFT OVERVIEW SCREEN



The left side of the Overview screen is used for System Control, Interlocks, and subsystem controllers.

The System pushbuttons at the top select the mode of operation: **Auto**, **Manual**, & **Service**. The current mode is indicated in green.

The currently running **Recipe Name** is displayed here, as well as the active **Sequence Running**, **Current Step**, **Run Number**, **Process Time** and buttons to **Start** or **Abort** the recipe sequence.

Recipe Name - Active automatic process composed of a series of recipe steps.

Sequence Running - Name of active recipe step.

Current Step - # of active recipe step and total # of recipe steps.

Process Time - Total process time from Start button until end of last recipe step. Resets at next Start button.

Run Number - a sequential number applied to the Datalog file for identification. **Reset** button resets the Run Number counter.

Step Timer - Count down timer for each process step. Displays remaining time until next process step. Resets at the next step.

Interlock status is displayed in this area of the Overview screen. **Green** = Satisfied; **Red** = Open

Selecting the bottom button provides access to the screen for the Gas and Target screen names. This screen is accessible only in Service Mode.

Gas Control provides text messages to indicate which type of gas control is active: Fixed Flow or Pressure Control (PID).

AUTO

Auto mode is used to run automatic recipes. The Start, Stop, and Abort buttons are active in this Mode. The current Recipe Running, Current Step, Sequence Running, and Total Process Time will advance as the automatic recipe is running.

The Run Number is incremented every time the **Start** button is pressed. This feature can be customized to match customer run numbering. Contact Denton Vacuum for more information.

The **Start** button starts the Recipe that is displayed. The Stop button stops the recipe at the end of the current Sequence Running. The **Abort** button stops the automatic process immediately and resets the recipe back to the beginning and resets the Total Process Time.

All buttons change to green when active or ON.



Note: Access to all other on-screen controls is denied in the Auto mode. This interlock is built in to avoid manual operation of a subsystem in the Auto Mode.

MANUAL

The operator can safely run the system from the Overview screen in the Manual mode. All interlocks are active in Manual mode. Recipes are not active in Manual mode.

All on-screen control systems are available. Clicking on the graphic for an item can change the state of the valves, motors and fixture rotation. Clicking will change the state of simple on/off, open/closed devices or open control boxes for more sophisticated controls. Double-clicking activates all the Status & Control boxes on both sides of the screen. Pop-up boxes are displayed for operator input.

The Total Process Time will not advance and the Start and Stop buttons are inactive in Manual mode. The Reset button is inactive in the Manual mode.

SERVICE



CAUTION: Software Interlocks are inactive in service mode. Caution must be taken to safely operate the vacuum system



NOTE: Service Mode is not accessible to System Operators. Service Mode is only accessible to System Administrator. See System Security for complete details

Use Service Mode for maintenance. Software interlocks are inactive in this mode. Hardwired interlocks are active in service mode. All control systems are active as in Manual mode.

Access to Service mode is password protected.

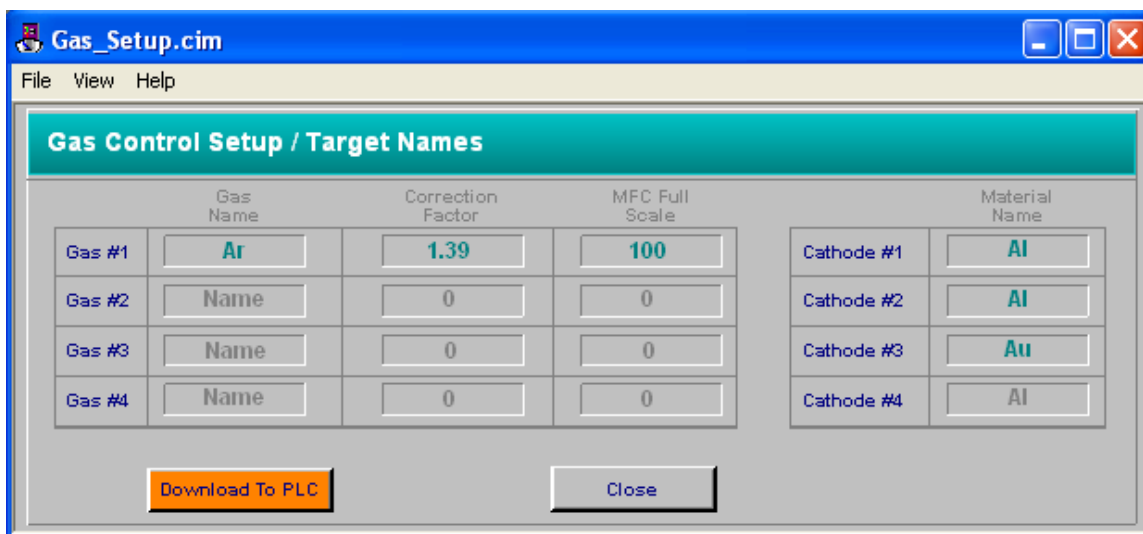


INTERLOCKS

To the left of each item in the interlock listing is a rectangle that is either green or red, indicating whether that particular interlock is met or not met, respectively.

Sputter guns, heater, bias will not operate if any interlock is open. These are hardwired interlocks.

GAS CONTROL SETUP / TARGET NAMES



Gas Control Setup / Target Names					
	Gas Name	Correction Factor	MFC Full Scale		Material Name
Gas #1	Ar	1.39	100	Cathode #1	Al
Gas #2	Name	0	0	Cathode #2	Al
Gas #3	Name	0	0	Cathode #3	Au
Gas #4	Name	0	0	Cathode #4	Al

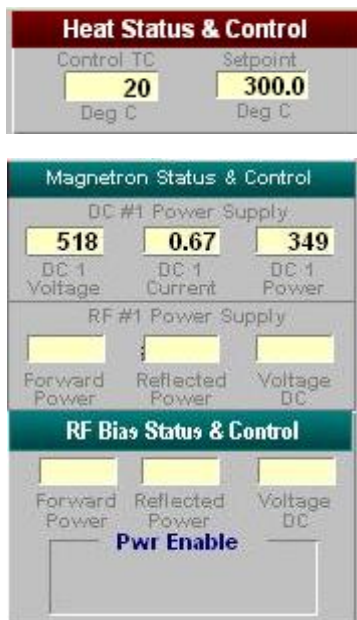
Download To PLC Close

Gas Control Setup / Target Names screen is accessed in Service Mode only. The names of the inlet gases, the gas correction factors, and the target materials can be programmed on this screen.



NOTE: The Data input to this screen MUST be downloaded to the PLC to be permanent. After entering changes and before pressing the Close button, you MUST press the Download To PLC button to make the changes permanent.

RIGHT OVERVIEW SCREEN



The control boxes for all major subsystems are displayed on the right side of the Overview screen. The current condition of the subsystems is continuously displayed on the right side of the Overview screen in data boxes. Double-clicking on the Status & Control box accesses the individual subsystems. A control box will pop-up with input boxes for operator interface with the subsystem. These are accessed in Manual Mode.

In normal operation the following data is continuously displayed on the Overview screen:

Heat Status & Control

Magnetron Status and Control (RF & DC)

RF Bias Status & Control

The individual subsystems are described below. The screens are operated in Manual Mode only.

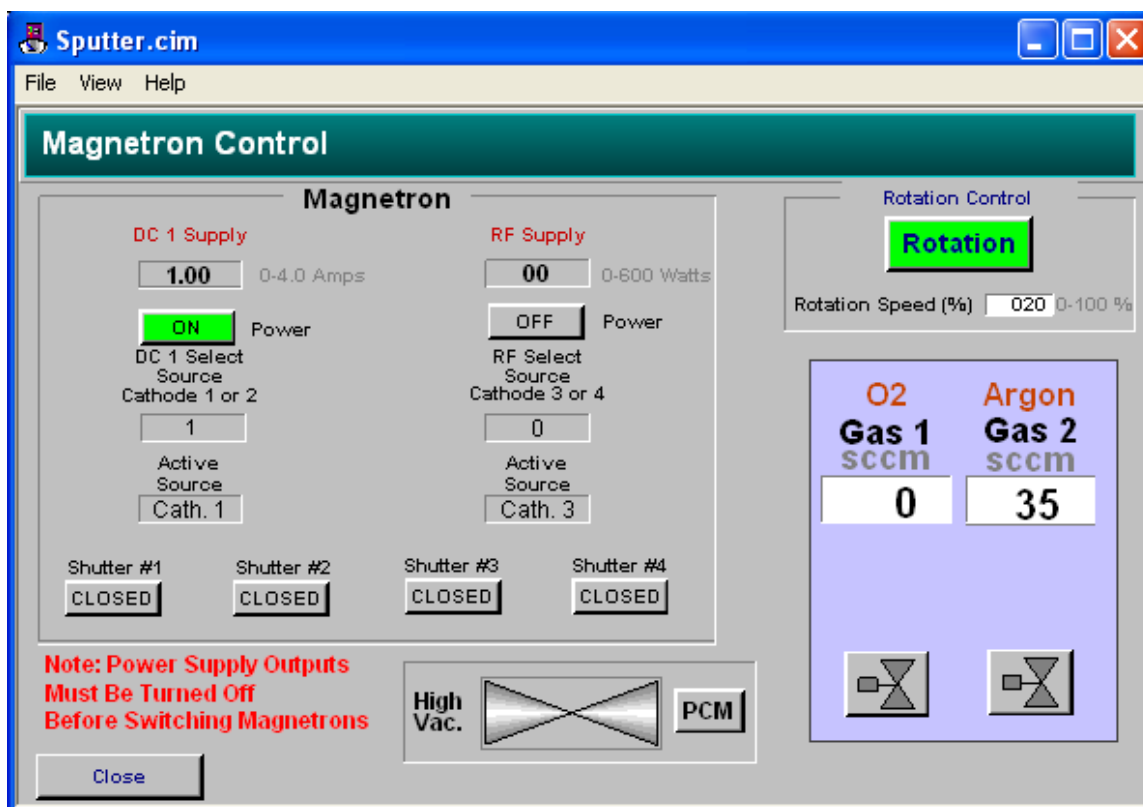
This screen can be used to operate and monitor a heat process. All the pertinent controls and system feedback data is present here. The Temperature and Power bar blocks are color dependent based on system condition and control parameters. The Setpoint bar is a visual representation of the temperature setpoint. The PV bar shows the instantaneous temperature measured by the controlling thermocouple. The CV bar shows the percentage of power supply output applied at that moment.

The Vent Valve interlock temperature (Vent Temp) can be set on this screen.



NOTE: The Vent Valve cannot be opened when the substrate temperature is above the Vent Valve Interlock temperature setpoint.

SPUTTER CONTROL



NOTE: Access to this screen is available in Manual and Service modes only.



NOTE: Power must be OFF before switching between cathodes.



NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.



Before trying to ignite a plasma, you must have the Process Gas flowing!!!

RF

Open the appropriate Gas Valve and input a flow setpoint. Adjusting the gas inlet flow will control chamber pressure.

This screen allows operation of the RF power supply connected to Cathode #3 and #4. To select the power level, click on the setpoint box and type in power setting, then hit enter. RF power setpoint range is 0-600 watts.

To “Turn On” the power supply, click the On/Off button in that block.

Open and close the shutter from this screen.



Note: The power supply is interlocked with system vacuum, water, skin switch and rotation.



Caution: Before Trying to Ignite the plasma, you MUST first have the Process Gas flowing!!! Gas controls are available at the bottom of this screen.

If the RF plasma requires a higher pressure to ignite than obtained with the selected flow, the High Vac Valve may be closed temporarily; just long enough to attain RF ignition. The valve must then immediately be opened.

The substrate Rotation setpoint can be set from this screen.

Gas Controls are also available from this screen.

Use the close button to exit the screen.

DC

Open the appropriate Gas Valve and input a flow setpoint. Adjusting the gas inlet flow will control chamber pressure.

This screen provides operation of the DC power supplies connected to Cathode #1 and #2. To select the power level, click on the setpoint box and type in power setting, then hit enter. DC power setpoint range is 0-1 Amp.

To “Turn On” the power supply, click the On/Off button in that block.

Open and close the shutter from this screen.



Note: The power supply is interlocked with system vacuum, water, skin switch and rotation.



Caution: Before Trying to Ignite the plasma, you Must First have the Process Gas flowing!!!
Gas controls are available at the bottom of this screen.

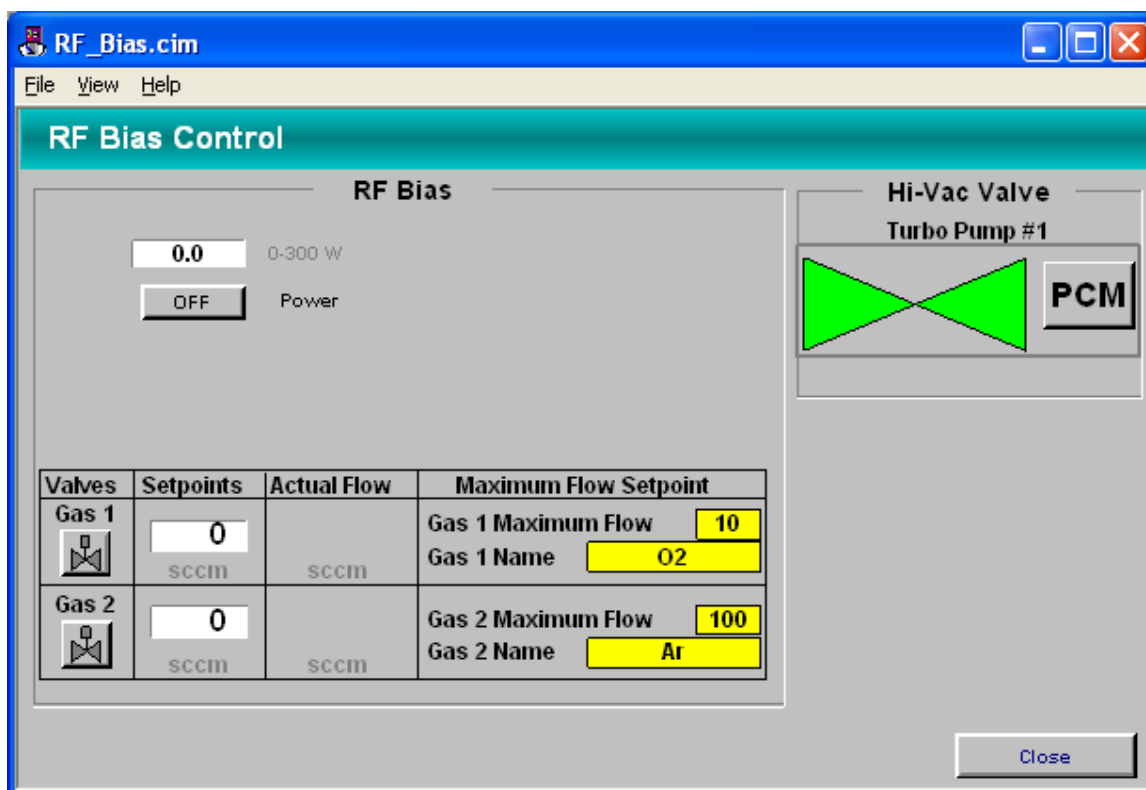
If the DC plasma requires a higher pressure to ignite than obtained with the selected flow, the High Vac Valve may be closed temporarily; just long enough to attain RF ignition. The valve must then immediately be opened.



The substrate Rotation setpoint can be set from this screen.

Gas Controls are also available from this screen.

Use the close button to exit the screen.

RF BIAS CONTROL



Valves	Setpoints	Actual Flow	Maximum Flow Setpoint
Gas 1 	0 sccm	sccm	Gas 1 Maximum Flow 10 Gas 1 Name O2
Gas 2 	0 sccm	sccm	Gas 2 Maximum Flow 100 Gas 2 Name Ar



NOTE: Access to this screen is available in Manual and Service modes only.



NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.



Before trying to ignite a plasma, you must have the Process Gas flowing!!!

This screen allows operation of the Biased Substrate Table. 300 watts should be the normal upper limit for operation. To select the power level, click on the setpoint box and type in power setting, then hit enter.

To “Turn On” the power supply, click the On/Off button in that block.



Note: The power supply is interlocked with system vacuum, water, skin switch and rotation.



Caution: Before Trying to Ignite the plasma above the table, you Must First have the Process Gas flowing!!! Gas controls are available at the bottom of this screen.

If the RF plasma requires a higher pressure to ignite than obtained with the selected flow, the High Vac Valve may be closed temporarily; just long enough to attain RF ignition. The valve must then immediately be opened.

To select the power level, click on the setpoint box and type in power setting, then hit enter. RF power setpoint range is 0-300 watts.

Open the appropriate Gas Valve and input a flow setpoint. Adjusting the gas inlet flow and opening the High Vacuum Valve in the PCM setting will control chamber pressure.

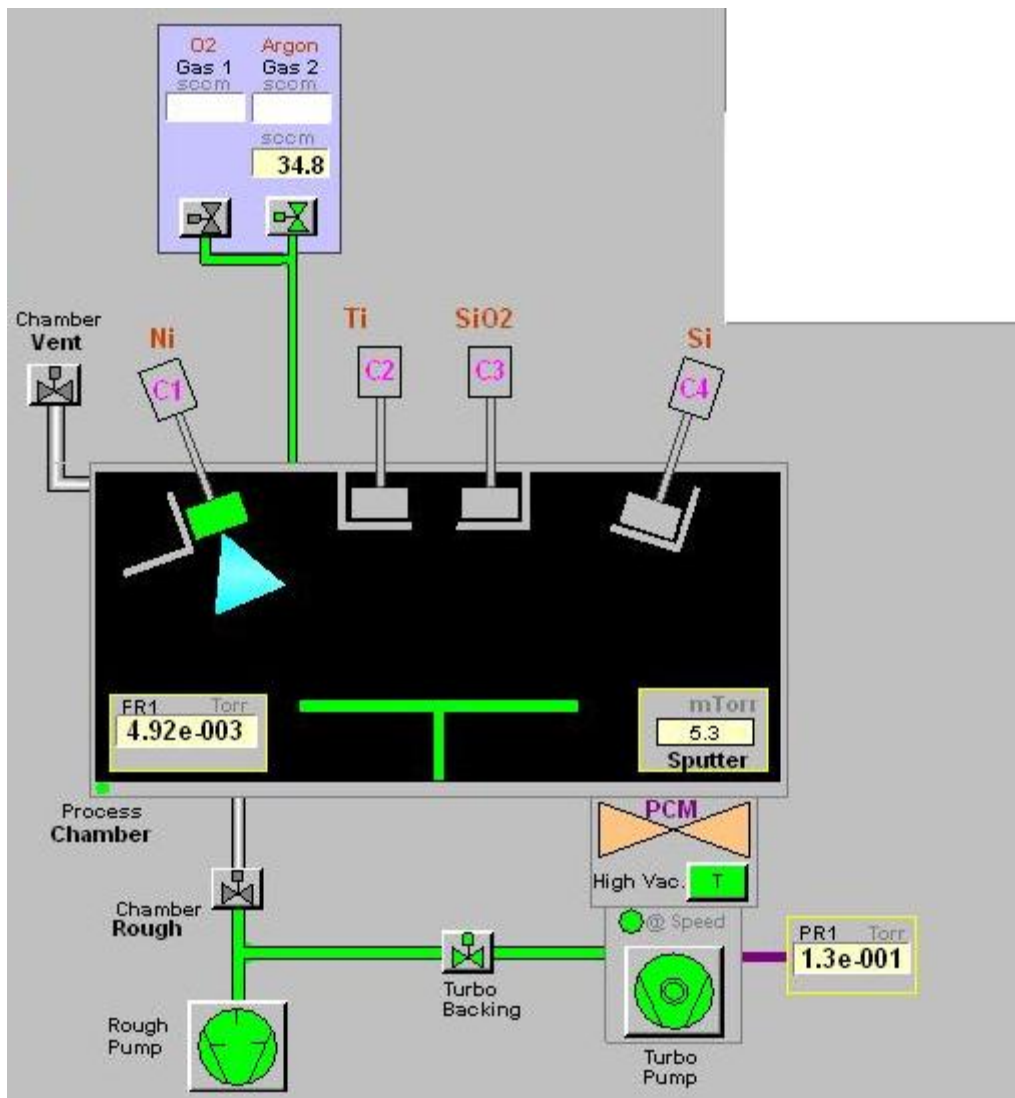
The High Vacuum Valve can be operated in three modes: Open, Closed, and Pressure Control Mode (PCM). Pressure Control Mode is a partial open state. The position of the valve in this mode is adjustable manually on the body of the valve. See the operating instructions from the valve manufacturer for detailed instructions.

If the RF plasma requires a higher pressure to ignite than obtained with the selected flow, the High Vac. Valve may be closed temporarily; just long enough to attain RF ignition. The valve must then immediately be opened and set at the PCM mode.

Rotation of the substrate stage may be enabled or disabled by the button on the Overview screen.

Use the close button to exit the screen.

CENTER OVERVIEW SCREEN



Displays current state of the vacuum gauges and power supplies in this area of the screen.



NOTE: All relevant interlocks must be satisfied before a subsystem will respond. See the Interlock section of this manual.

A graphic representation of the vacuum chamber, fixture rotation, and pumping system is displayed on the center of the Overview screen. All components of the pumping system are accessible in Manual or Service modes. Double-click on a component to change the state

(on/off, open/closed) of the component or double-click on a component and a control box will pop-up for operator control input.

NOTE: Access to the status & control boxes is denied in Auto mode.

Vacuum chamber graphics are used to display the current condition of major subsystems.

Rotation and Heat indicators will be visible when either subsystem is active.

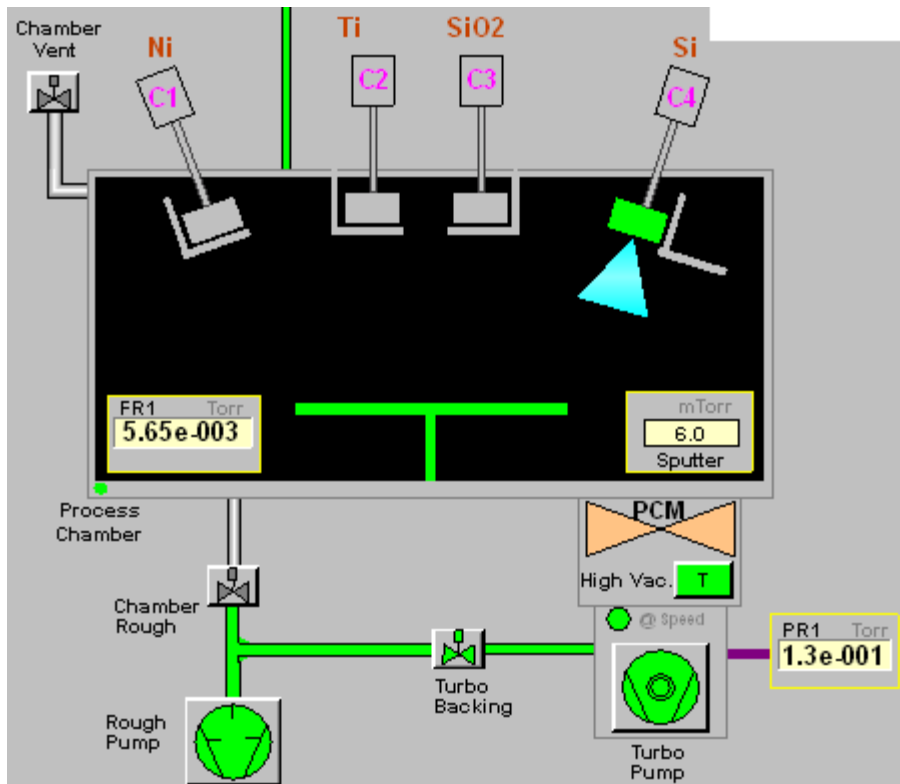
Cathodes and cathode shutter graphics will indicate actual conditions: ON/OFF or OPEN/CLOSE.

The full range gauge (FR1) operations (Degas & Reset) can be accessed from this area of the Overview screen. The gauge can be operated ON/OFF and the Degas can be activated in SERVICE MODE ONLY.



NOTE: Chamber pressure must be less than $1e-4$ Torr before operating the Degas feature. Degas function is limited to three minutes in the gauge controller.

PUMPING SYSTEM / CHAMBER



Manual operation of the vacuum system is available from this area of the Overview screen. Pumps and Valves can be operated safely in Manual mode in accordance with the software interlocks. Vacuum pressure is displayed in real time at all times on the Overview screen.

The High Vacuum Valve can be operated in three modes: Open, Closed and Pressure Control Mode (PCM). Pressure Control Mode is a partial open state. The position of the valve in this mode is adjustable manually on the body of the valve when the valve is in Open mode. See the operating instructions from the valve manufacturer for detailed instructions.

Green = On or Open; **Gray** = Off or Closed; **Yellow** = between Open and Closed.

Graphical or digital displays active on the Overview screen at all times:

Pressure displays from all vacuum pressure gauges.

The Turbo Pump @ Speed indicates LED.



NOTE: Software interlocks are NOT active in Service Mode. Care must be taken to operate the vacuum system in Service Mode.

Graphical or digital displays active on the Overview screen at all times:

The digital output of the Capacitance Manometer (Sputter Pressure mTorr).

Actual Gas flow through each mass Flow Controller (SCCM).

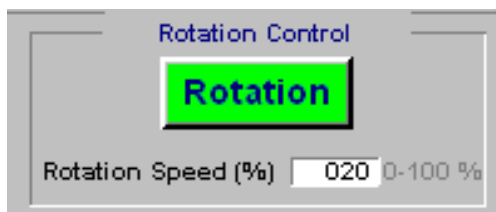
Gas Valves Open/Close.

Cathode Shutters Open/Close.

Substrate Heater On/Off

Door Open

ROTATION



Rotation Control is accessed on the Overview screen.

Rotation ON/OFF and rotation speed controls are available on this screen.

Rotation speed setpoint is 0 –100% of full speed.



NOTE: Rotation is an interlock for substrate heat and RF bias.

AUTO MODE PROCESS DATA

Step Number	C4_S1_T002.dat
Step Time (sec)	3000
Vacuum Setpoint (Torr)	1.0e+001
Heat Temperature Setpoint (Deg.C)	0
Gas 1-Setpoint (sccm)	0
Gas 2-Setpoint (sccm)	35
	0
	0
	0
	0
	0
	0
	0
	0
RF Source - PreSputter (Watts)	0
RF Source -Sputter (Watts)	350
RF Source Select	4
DC 1 Source - PreSputter (Amps)	0.0
DC 1 Source - Sputter (Amps)	0.0
DC 1 Source Select	0
	0.0
	0
Pressure Control	Yes
Ignition Pressure (mTorr)	0
RF Bias Setpoint	0
Rotation Speed (0-100 %)	50
End Process (Yes)	0.0
	0

In the Auto Mode, the programmed setpoints for each process step are displayed on the Overview screen. Each process step is programmed through the Recipe screen. Complete details on programming an Automatic deposition are contained in the Recipe section of this manual.

As each step becomes active, the setpoints for the step will be displayed on the upper left corner of the Overview screen. This display is intended to provide information on the exact position of the automatic sequence.

The setpoint data is displayed to provide a comparison against the actual data displayed on the right side of the Overview screen.

MAIN CHAMBER VENT– AUTOMATIC MODE

MAIN CHAMBER VENTING – MANUAL MODE

This procedure assumes the chamber is in high vacuum. Make sure all valves, power supplies, and gauges are OFF or closed. Finish or abort any automatic sequences that may be running.

Wait until the chamber is at a low enough temperature to vent the chamber.



NOTE: The chamber Vent Valve is interlocked to the substrate temperature. The Vent Valve will not open in Auto or Manual Modes when the substrate temperature is above the Vent Temp setpoint on the Heat Control screen.

Close the high vacuum valve.